Environmental Resources Management

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6 October 2006

Mr. Matt McClincy
Oregon Department of Environmental Quality
Northwest Region
2020 Southwest Fourth Avenue
Suite 400
Portland, Oregon 97201-4987

Subject: Upland Groundwater Dioxin/Furan Sampling
Technical Memorandum
Arkema Inc., Portland Facility

Dear Mr. McClincy:

This technical memorandum was prepared by ERM-West, Inc. (ERM) on behalf of Legacy Site Services LLC (LSS) to summarize the groundwater sampling results for dioxin/furans at the Arkema, Inc., facility (the Site) in Portland, Oregon. This sampling was conducted in response to the Oregon Department of Environmental Quality (ODEQ) letter dated 14 June 2006 requesting Arkema, Inc./LSS to screen for dioxin/furans in upland groundwater at the Site. ODEQ requested this work be done in order to "confirm that upland dioxin/furan sources requiring remedial measures (e.g. source control) are not present". Based on LSS' reasonable evaluation of the work, we believe the data clearly demonstrate that upland groundwater is not a source of dioxin/furan which requires remedial measures. The work was completed in accordance with the work plan letter submitted by LSS on 31 July 2006 and approved by ODEQ by letter dated 7 August 2006.

The field procedures used to collect the samples and the results of the laboratory analyses are presented below.

Field Procedures

On 15 August 2006, ERM sampled 11 groundwater monitoring wells located within and downgradient of the former Acid Plant and Chlorate Manufacturing Areas. Field sampling was performed in accordance with the procedures

outlined in the Field Sampling Plan in the Remedial Investigation/Feasibility Study Work Plan (Exponent 1998) and the sampling plan addendum (LSS, 31 July 2006). These procedures cover well purging, field parameter collection, and quality assurance/quality control protocols.

The depth to groundwater was measured in each well prior to purging with a low-flow bladder pump. Field parameters were measured and recorded during purging. Once the field parameters stabilized, the samples were collected in two 1-liter amber glass bottles. Sample labeling, shipping, and chain of custody procedures were in accordance with the Field Sampling Plan. The samples were shipped to STL Inc. laboratories in Sacramento, California, for analysis of dioxins/furans using United States Environmental Protection Agency (USEPA) Method SW8290.

Toxicity Equivalence Quotient Method

The generally accepted method for comparing dioxin/furan results against a given criteria consists of calculating a toxicity equivalence quotient (TEQ) relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin. The results for individual analytes are multiplied by a factor and the results totaled to provide an overall concentration value for the sample. Two sets of generally accepted toxicity equivalence factors were applied to the results to calculate TEQs: one set endorsed by the USEPA; and the other endorsed by the World Health Organization. The factors used are presented in Table 2. Only positively identified compounds were included in the TEQ calculations.

Groundwater Monitoring Results

The depths to groundwater and field parameter results are presented in Table 1. The laboratory analytical results are presented in Table 2 and on Figure 1. The laboratory data was reviewed for quality assurance/quality control compliance. The data validation report is provided in Attachment A.

Furans were detected in five of the 11 monitoring wells (MWA-4, MWA-6r, MWA-15r, MWA-46, and MWA-67si). The detections were generally for TCDF, PeCDF, and HxCDF, with TEQs ranging between 0.54 and 52.7 picograms per liter (pg/L).

Dioxins were detected in only one groundwater sample (MWA-6r), and that detection was qualified as a "J value" (estimated). The dioxin detected was OCDD, which is the lowest toxicity dioxin congener (TEQ factor of 0.001 to 0.0001; three to four orders of magnitude lower than TCDD). No other dioxins were detected during this sampling event.

There were no detections of dioxins/furans in the intermediate aquifer monitoring wells – all detections were limited to the shallow and shallow-intermediate wells.

Discussion of Results

The Portland Harbor Joint Source Control Strategy (JSCS) (USEPA and ODEQ, December 2005) provides the following initial screening values be considered for dioxin/furans in water:

- ODEQ 2004 chronic Ambient Water Quality Criteria (AWQC) for protection of ecological receptors (380 pg/L);

- Federal Maximum Contaminant Limit (MCL) drinking water standard (30 pg/L);

- USEPA Region IX Tap Water Preliminary Remediation Goal (PRG) (0.45 pg/L); and

- USEPA 2004 National Recommended Water Quality Criteria (WQC) for fish consumption (17.5 grams per day organism only) (0.0051 pg/L).

These screening values are included in Table 2; however, we do not consider these values appropriate standards for direct comparison to the Site groundwater results for the reasons described below.

- As discussed in the conditionally-approved Remedial Investigation Report for the Site (ERM 2005), the Site is located within an Industrial Sanctuary and the groundwater is not currently used nor is it reasonably likely to be used in the future as a drinking water source. Therefore, comparison of groundwater concentrations to drinking water standards, such as the Region IX Tap Water PRG and MCL, is not appropriate.

- The ODEQ AWQC and the USEPA WQC are guideline values for surface water where ecological receptors are present. The upland groundwater sample results collected as part of this scope of work are not representative of surface water conditions at the Site. Thus, direct comparison of the groundwater sample results to surface water standards, such as the ODEQ AWQC and the USEPA WQC, is not appropriate.

- The USEPA WQC for 2,3,7,8-TCDD (dioxin) (0.0051 pg/L) is a value several orders of magnitude below the method detection limits achievable by most analytical laboratories. This value has been widely challenged based on several overly-conservative assumptions made in the calculation for this value. Examples of some of the challenged assumptions include: 1) USEPA's assumption that all fish consumed are contaminated at the criteria level, 2) the assumed value of daily water intake of fish per day, 3) the assumed amount of fish consumed per day by a hypothetical human receptor, and 4) the methods for calculating several key factors (e.g., bioaccumulation factor) used in the calculation of the WQC values. [a,b]

It should be noted that all TEQs for the collected groundwater samples are below the ODEQ 2004 chronic AWQC for protection of ecological receptors (380 pg/L). In addition, only one detection (MWA-4) was above the Federal MCL drinking water standard (30 pg/L).

Based on these limited detections below many of the conservative JSCS screening values, LSS does not believe that groundwater at the Site represents a source of dioxins or furans. Therefore, dioxins and furans in groundwater in the former Acid Plant and Chlorate Manufacturing Areas do not represent a significant risk to surface water or sediment and do not require remedial measures or warrant additional evaluation.

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[a] *National Toxics Rule: Remand of Water Quality Criteria for Dioxin and Pentachlorophenol to USEPA for Response to Comments*, Federal Register: December 11, 1996 (Volume 61, Number 239).
[b] *Revisions to the Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health*, Federal Register: November 3, 2000 (65FR66443).

If you have any questions or require additional information, please feel free to contact us at (425) 462-8591.

Sincerely,

Erik C. Ipsen, P.E.
Project Manager

David P. Edwards, P.G.
Partner

DPE/ECI/dwb/54012.03

Attachments

cc: Todd Slater/LSS
Larry Patterson/ERM

Figure

Project No. 00306769.03
Date: 09/26/06
Drawn By: J. Estrada
CAD File: g:\00306769\03\02\00306769030003-02.dwg

HARBOR LINE N 41°02'35" 1617.03'

MWA-67si 0.54 | 0.54
MWA-2 0.00 | 0.00
MWA-4 52.70 | 52.70
MWA-10i 0.00 | 0.00
MWA-6r 2.15 | 2.11
MWA-16i 0.00 | 0.00
MWA-46 5.00 | 5.00
MWA-32i 0.00 | 0.00
MWA-30 0.00 | 0.00
MWA-63 0.00 | 0.00
MWA-15r 16.60 | 16.60

MWA-13d, MWA-3, MWA-9i, MWA-21b, MWA-64i, MWA-61, MWA-8i, MWA-17si, MWA-68si, MWA-66i, MWA-69, MWA-6, MWA-65i, MWA-62, MWA-60, MWA-14i, MWA-5, MWA-42, MWA-54i, MWA-11i, MWA-22, MWA-1, MWA-49i, MWA-58d, MWA-19, MWA-34i, MWA-56d, MWA-18, MWA-51i, MWA-44, MWA-45, MWA-31i(d), MWA-47, MWA-50i, MWA-59d, MWA-20, MWA-57d, MWA-55i, MWA-27, MWA-52i, MWA-28i(d), MWA-35, MWA-25, MWA-36, MWA-48i, MWA-37, MWA-24, MWA-38, MWA-26, MWA-40

FORMER MPR POND AND TRENCH
WAREHOUSE No. 3
LOADING DOCK
FORMER ACID PLANT
FORMER CONTROL HOUSE
PROCESS
DDT PROCESS BUILDING
OLD CAUSTIC TANK FARM
POSSIBLE DDT LOADING AREA
MCB RECOVERY UNIT
TRUCK SALT DROP
SALT PAD
SALT PADS
OIL STORAGE
SALT PAD #1
CELL LIQUOR STORAGE
WAREHOUSE No. 2
DDT WAREHOUSE (MILLING & BAGGING)
DDT DRY STORAGE AREA
WASTEWATER TREATMENT
NEW CAUSTIC TANK FARM
CAUSTIC RAIL LOAD'G
WAREHOUSE
CHLORINE FINISHING
BOILER ROOM
RECTIFIER
SUB-STATION
CHLORATE CELL ROOM
NITROGEN GAS

LEGEND

MWA-47	Monitoring Well, Shallow Zone
MWA-68si	Monitoring Well, Shallow and Intermediate Zone
MWA-49i	Monitoring Well, Intermediate Zone
MWA-56d	Monitoring Well, Deep Zone
MWA-21b	Monitoring Well, Basalt

5.00 | 5.00
WHO 1997 – TEQ based on World Health Organization 1997 endorsed toxicity equivalency factors
EPA 1989 – TEQ based on US Environmental Protection Agency 1989 endorsed toxicity equivalency factors

TRUE NORTH
PLANT NORTH
0 100
FEET

Note:
Most buildings and structures noted on this diagram have been demolished and/or removed.

Figure 1
Toxicity Equivalency Quotient Results - 15 August 2006
Dioxin/Furan Groundwater Screening
Arkema Inc.
Portland, Oregon
ERM 09/06

Tables

Table 1
Field Parameters
Upland Groundwater Dioxin/Furan Screening
Arkema, Inc. Facility
Portland, Oregon

Well Number	Sample Number	Date	Measuring Point Elevation	Depth to Groundwater (feet)	Groundwater Elevation (feet amsl)	pH	Temp. (deg. C)	EC (mS/cm)	ORP (mV)	DO (mg O_2/L)	Turbidity (NTU)
Shallow Zone											
MWA-2	MWA-02-081506	8/15/06	38.46	28.37	10.09	5.90	16.80	2.59	193.0	0.48	4.0
MWA-4	MWA-04-081506	8/15/06	38.44	27.74	10.72	7.66	16.60	2.470	60.0	0.36	3.0
MWA-6r	MWA-6r-081506	8/15/06	36.46	25.25	13.21	9.58	17.30	13.200	73.0	0.31	11.0
MWA-15r	MWA-15r-081506	8/15/06	36.06	24.60	13.86	7.84	20.20	2.140	-8.0	0.43	78.0
MWA-30	MWA-30-081506	8/15/06	38.34	27.30	11.16	7.74	18.20	100*	-104.0	0.62	80.0
MWA-46	MWA-46-081506	8/15/06	36.67	26.32	12.14	8.56	19.00	8.08	53.00	0.51	58.0
MWA-63	MWA-63-081506	8/15/06	36.29	26.20	12.26	6.99	15.50	3.750	125.0	0.85	2.0
Shallow Intermediate Zone											
MWA-67si	MWA-67si-081506	8/15/06	36.34	26.42	12.04	4.67	17.30	11.1	285.0	1.80	3.0
Intermediate Zone											
MWA-10i	MWA-10i-081506	8/15/06	37.89	28.55	9.91	7.46	16.90	7.26	-18.0	0.63	9.0
MWA-16i	MWA-16i-081506	8/15/06	36.72	27.25	11.21	7.80	18.40	11.9	-56.0	0.59	2.0
MWA-32i	MWA-32i-081506	8/15/06	38.70	28.95	9.51	7.90	19.00	55.7	-20.0	0.42	85.0

Notes:
feet amsl = feet above mean sea level
deg. C = degrees Celsius
mS/cm = milliSiemens per centimeter
mV = millivolts
mg = milligrams
NTU = Nephelometric Turbidity Unit
* = Measurement exceeds range of field meter

Table 2
Dioxin/Furan Analytical Results
Upland Groundwater Dioxin/Furan Screening
Arkema, Inc. Facility
Portland, Oregon

													Regulatory Standards			
Well Number	Units	TEQ Factors		MWA-2	MWA-4	MWA-6r	MWA-10i	MWA-15r	MWA-16i	MWA-30	MWA-32i	MWA-46	MWA-63	MWA-67si	Protection of Human Health			Protection of Ecological Receptors
Sample Number		EPA	WHO	MWA-2-081506	MWA-4-081506	MWA-6R-081506	MWA-10I-081506	MWA-15R-081506	MWA-16I-081506	MWA-30-081506	MWA-32I-081506	MWA-46-081506	MWA-63-081506	MWA-67SI-081506	Drinking Water		Fish Consumption	
Date				8/15/06	8/15/06	8/15/06	8/15/06	8/15/06	8/15/06	8/15/06	8/15/06	8/15/06	8/15/06	8/15/06	MCL[1]	Tap Water PRG [2]	EPA 2004 NRWQC [3]	DEQ 2005 AWQC [4]
2,3,7,8-TCDD	(pg/L)	1	1	ND (<1.9)	ND (<1.8)	ND (<3.2)	ND (<1.8)	ND (<2)	ND (<2.1)	ND (<1.8)	ND (<1.7)	ND (<2.1)	ND (<1.7)	ND (<1.7)		0.45	0.0051	380
Total TCDD	(pg/L)			ND (<1.9)	ND (<1.8)	ND (<3.2)	ND (<1.8)	ND (<2.3)	ND (<2.1)	ND (<1.8)	ND (<1.7)	ND (<2.1)	ND (<1.7)	ND (<1.7)				
1,2,3,7,8-PeCDD	(pg/L)	0.5	1	ND (<4.7)	ND (<4.1)	ND (<7.4)	ND (<5.2)	ND (<4.4)	ND (<5.7)	ND (<5)	ND (<5)	ND (<6)	ND (<4.9)	ND (<5.1)				
Total PeCDD	(pg/L)			ND (<4.7)	ND (<4.1)	ND (<7.4)	ND (<5.2)	ND (<4.4)	ND (<5.7)	ND (<5)	ND (<5)	ND (<6)	ND (<4.9)	ND (<5.1)				
1,2,3,4,7,8-HxCDD	(pg/L)	0.1	0.1	ND (<4.1)	ND (<3.8)	ND (<7.7)	ND (<4.4)	ND (<3.4)	ND (<5)	ND (<3.6)	ND (<3.9)	ND (<4.9)	ND (<4.3)	ND (<4.2)				
1,2,3,6,7,8-HxCDD	(pg/L)	0.1	0.1	ND (<3.8)	ND (<3.6)	ND (<7.1)	ND (<4.1)	ND (<3.1)	ND (<4.6)	ND (<3.4)	ND (<3.6)	ND (<4.6)	ND (<4)	ND (<3.9)				
1,2,3,7,8,9-HxCDD	(pg/L)	0.1	0.1	ND (<3.7)	ND (<3.5)	ND (<7)	ND (<4)	ND (<3)	ND (<4.5)	ND (<3.3)	ND (<3.5)	ND (<4.4)	ND (<3.9)	ND (<3.8)				
Total HxCDD	(pg/L)			ND (<4.1)	ND (<3.8)	ND (<7.7)	ND (<4.4)	ND (<3.4)	ND (<5)	ND (<3.6)	ND (<3.9)	ND (<4.9)	ND (<4.3)	ND (<4.2)				
1,2,3,4,6,7,8-HpCDD	(pg/L)	0.01	0.01	ND (<4.6)	ND (<5.4)	ND (<9.6)	ND (<4.6)	ND (<7.6)	ND (<4.9)	ND (<4.5)	ND (<4)	ND (<5.9)	ND (<4.9)	ND (<4.2)				
Total HpCDD	(pg/L)			ND (<4.6)	ND (<5.4)	ND (<9.6)	ND (<4.6)	ND (<7.6)	ND (<5.8)	ND (<4.5)	ND (<4)	ND (<7.9)	ND (<4.9)	ND (<4.2)				
OCDD	(pg/L)	0.001	0.0001	ND (<4.6)	ND (<5.1)	53 J	ND (<5.7)	ND (<20)	ND (<32)	ND (<5)	ND (<14)	ND (<38)	ND (<4.8)	ND (<5.3)				
2,3,7,8-TCDF	(pg/L)	0.1	0.1	ND (<3.3)	180	21	ND (<1.9)	52	ND (<2.9)	ND (<1.9)	ND (<2.4)	13	ND (<2.2)	5.4 J				
Total TCDF	(pg/L)			ND (<3.3)	490	41	ND (<2)	120	ND (<2.9)	ND (<1.9)	ND (<3.1)	24	ND (<2.2)	16				
1,2,3,7,8-PeCDF	(pg/L)	0.05	0.05	ND (<3)	100	ND (<15)	ND (<3.1)	110	ND (<3.7)	ND (<2.9)	ND (<3.1)	ND (<23)	ND (<2.6)	ND (<4.6)				
2,3,4,7,8-PeCDF	(pg/L)	0.5	0.5	ND (<2.9)	43 J	ND (<5.3)	ND (<3.1)	ND (<21)	ND (<3.6)	ND (<2.8)	ND (<3.1)	ND (<7.5)	ND (<2.6)	ND (<3)				
Total PeCDF	(pg/L)			ND (<3.1)	220	ND (<15)	ND (<3.4)	170	ND (<4.7)	ND (<3.1)	ND (<3.2)	ND (<23)	ND (<2.9)	ND (<4.6)				
1,2,3,4,7,8-HxCDF	(pg/L)	0.1	0.1	ND (<4.6)	82	ND (<24)	ND (<5.4)	59	ND (<6.1)	ND (<4.6)	ND (<5.4)	37 J	ND (<5.6)	ND (<9.5)				
1,2,3,6,7,8-HxCDF	(pg/L)	0.1	0.1	ND (<4.3)	ND (<21)	ND (<9)	ND (<5.1)	ND (<12)	ND (<5.8)	ND (<4.3)	ND (<5.1)	ND (<11)	ND (<5.3)	ND (<4.9)				
2,3,4,6,7,8-HxCDF	(pg/L)	0.1	0.1	ND (<4.7)	ND (<7.4)	ND (<9.7)	ND (<5.5)	ND (<5.8)	ND (<6.3)	ND (<4.7)	ND (<5.5)	ND (<6.2)	ND (<5.8)	ND (<5.3)				
1,2,3,7,8,9-HxCDF	(pg/L)	0.1	0.1	ND (<5.1)	ND (<8)	ND (<11)	ND (<6)	ND (<6.3)	ND (<6.8)	ND (<5.1)	ND (<6)	ND (<6.8)	ND (<6.3)	ND (<5.8)				
Total HxCDF	(pg/L)			ND (<5.1)	82	ND (<24)	ND (<6)	59	ND (<6.8)	ND (<5.1)	ND (<6)	37	ND (<6.3)	ND (<9.5)				
1,2,3,4,6,7,8-HpCDF	(pg/L)	0.01	0.01	ND (<2.6)	ND (<19)	ND (<7)	ND (<2.8)	ND (<6.1)	ND (<3.6)	ND (<2.9)	ND (<3.2)	ND (<11)	ND (<2.8)	ND (<4.3)				
1,2,3,4,7,8,9-HpCDF	(pg/L)	0.01	0.01	ND (<3.2)	ND (<8.9)	ND (<5.3)	ND (<3.4)	ND (<2.3)	ND (<4.4)	ND (<3.5)	ND (<3.9)	ND (<3.5)	ND (<3.5)	ND (<3.6)				
Total HpCDF	(pg/L)			ND (<3.2)	ND (<19)	ND (<7)	ND (<3.4)	ND (<6.1)	ND (<4.4)	ND (<3.5)	ND (<3.9)	ND (<11)	ND (<3.5)	ND (<4.3)				
OCDF	(pg/L)	0.001	0.0001	ND (<5.6)	ND (<16)	ND (<9.5)	ND (<6.4)	ND (<4.6)	ND (<7.5)	ND (<5.8)	ND (<5.7)	ND (<11)	ND (<6.4)	ND (<4.9)				
EPA 1989 TEQ	(pg/L)			0.00	52.70	2.15	0.00	16.60	0.00	0.00	0.00	5.00	0.00	0.54	30	0.45	0.0051	
WHO 1997 TEQ	(pg/L)			0.00	52.70	2.11	0.00	16.60	0.00	0.00	0.00	5.00	0.00	0.54	30	0.45	0.0051	

Notes:
pg/L = picograms per liter (1E-12 g/L)
J = Estimated Value
ND = Not Detected (detection limit)
TEQ = Toxic Equivalency Quotient to 2,3,7,8-TCDD. Only positively identified compounds are included in TEQ calculation.
[1] - Federal Maximum Contaminant Limit (MCL)
[2] - EPA Region IX Preliminary Remediation Goal (PRG) for Tap Water
[3] - EPA 2004 National Recommended Water Quality Criteria - (17.5 g/day organism only)
4 - ODEQ 2004 chronic Ambient Water Quality Criteria (AWQC)
EPA = Environmental Protection Agency
WHO = World Health Organization

Attachment A

Quality Assurance/
Quality Control Evaluation

To ensure data quality was acceptable for decision-making purposes, ERM-West, Inc. (ERM) reviewed laboratory analytical results for the Arkema samples collected 15 August 2006 analyzed for dioxins/furans. The purpose of this review is to identify limitations on the use of the data and identify data that should not be used for decision-making purposes. The quality of the data was assessed and qualifiers were applied following the United States Environmental Protection Agency (*USEPA) Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA, October 1999).

ERM reviewed data for compliance with the following quality assurance/quality control (QA/QC) and method-prescribed criteria for level II review:

- **Holding Time and Sample Preservation:** The period of time between collection of the sample and preparation/analysis of the sample is evaluated. Analyses performed for this project have method-prescribed holding times as well as temperature and chemical preservation requirements.
- **Blank Samples:** The preparation and analysis of reagent (contaminant-free) water is evaluated. Blank samples for this investigation included method, trip, rinsate, and field blanks. Detections in a blank sample may indicate laboratory, transportation, or field contamination. All samples are evaluated for common laboratory contaminants during the blank evaluation.
- **Spike Samples:** The preparation and analysis of an environmental sample or a sample of reagent water spiked with a subset of target compounds at known concentrations are evaluated. The results of the spike analysis measure laboratory accuracy in the reagent sample, and results from the environmental sample spike measure potential interferences from the matrix.
- **Duplicate Samples:** The preparation and analysis of an additional aliquot of the sample is evaluated. The results from duplicate analysis measure potential heterogeneity of contaminants in the sample.

Level IV review was performed on the samples in the sampling event. The level IV review included all of the QA/QC project and/or method-prescribed criteria for level II review plus:

- **Calibration:** The analysis of target analytes at a range of concentrations to develop a graphical plot of instrument response against the different analyte concentrations. An initial calibration curve establishes the graphical plot, and the continuing calibration verification monitors daily instrument linearity against the initial calibration.
- **Internal standards:** The addition of compounds similar to target compounds of interest that are added to sample aliquots for organic analysis. The internal standards are used to quantitatively and qualitatively evaluate retention time and response for each sample.
- **Recalculation:** 10 percent of the initial calibration, continuing calibration, internal response, surrogate percent recoveries (%R), laboratory control sample (LCS) %R, matrix spike/matrix spike duplicate %R, and all of the detected sample concentrations were recalculated.

Potential USEPA qualifiers that may have been applied during the review process are as follows:

U (Nondetected): The analyte was reported as detected by the laboratory, but the reported concentrations should be considered nondetected above the laboratory reporting limit.

J (Estimated): The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.

N (Tentative identification): The analysis indicated the presence of an analyte for which there was presumptive evidence to make only a "tentative identification."

NJ (Estimated tentative identification): The analysis indicated the presence of an analyte that had been "tentatively identified" and the associated numerical value represents its approximate concentration.

UJ (Estimated, nondetected): The analyte was not detected above the reported sample quantitation limit; however, the reported quantitation limit was approximate and may or may not have represented the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R (Rejected): The sample results were rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte could not be verified.

None of the data were rejected during the data review. All data, including data qualified as estimated, are acceptable and can be used for decision-

making purposes. The following discussion addresses each of the QA/QC components listed above and the validation results for each of the components.

HOLDING TIME AND PRESERVATION

The USEPA has established a maximum sample holding time for each analysis. The USEPA has also established chemical and temperature preservation requirements for those analyses that may be subject to chemical degradation. Holding times and sample temperatures extending beyond the USEPA maximum or samples that are not properly preserved can negatively affect sample integrity (e.g., loss of volatile compounds, biodegradation) and are qualified depending on the severity of the exceedence and compounds of concern.

ERM has reviewed the analytical results for compliance with the method-prescribed preparation and analysis holding times as well as preservation requirements. The sample shipment was received in the laboratory at the appropriate temperature. The dioxin/furan analysis was conducted within the holding time. No data were qualified on the basis of holding time or temperature exceedances.

BLANK SAMPLES

A blank sample consists of contaminant-free reagent water and is prepared and analyzed in the same manner as the samples. The purpose of a blank sample is to determine the presence and magnitude of possible contamination resulting from laboratory, shipping, or other sample-handling activities. If target compounds are detected in a blank sample, then all associated data must be carefully evaluated to determine whether those results have been similarly impacted, or the blank problem is an isolated occurrence not representative of other data.

The two types of blank samples analyzed and reported with the Arkema samples were method and rinsate blank samples. Preparation, handling, and analysis of these blank samples are as follows:

- Method blank samples were prepared by the laboratory by taking an aliquot of reagent water through all preparation and analysis steps. A method blank was prepared and analyzed with each batch of environmental samples. Method blank samples monitor for potential contamination of samples from the laboratory.
- Rinsate blank samples were prepared in the field by slowly pouring reagent water over decontaminated sample collection equipment; the

water is then collected in sample bottles. Rinsate blank samples monitor for potential cross-contamination of project samples from insufficient decontamination procedures at the sample collection site.

The blanks were evaluated for detections of target analytes. No target analytes were detected in the blanks. No data required qualification based on blank results.

SPIKE SAMPLES

A spike sample is a QC sample that is prepared and analyzed by the laboratory in the same manner as the samples. The laboratory prepares, analyzes, and reports spike samples to demonstrate proper analysis, detection, and quantification of target compounds. The accuracy of spike samples is assessed by %R, which is calculated as the amount of the detected compound divided by the amount spiked into the sample. The %R is then compared to an established limit range. The two types of spike samples analyzed with the project samples were matrix spikes and blank spikes.

Blank spike samples, which are commonly referred to as LCS, consist of an aliquot of contaminant-free reagent water that is spiked with known concentrations of target compounds. The LCS sample monitors laboratory accuracy without the bias of a sample matrix. LCS recoveries outside of acceptable limits may indicate poor laboratory accuracy.

The LCS recoveries were within acceptable limits. No data were qualified on the basis of LCS results.

CALIBRATION EVALUATION

Before an analytical instrument is used for sample analysis, the instrument must be calibrated to be within USEPA method specifications. The purpose of this calibration is to ensure that the instrument is appropriately responsive to measurable chemical concentrations. If an instrument is not properly calibrated, it may not be capable of producing acceptable quantitative, qualitative, and reproducible data. For example, detected concentrations of a given compound that would still be considered valid could contain an undetermined degree of inaccuracy. In the case of non-detections, the reporting limit would be similarly affected; such results would still be considered non-detections.

Two types of calibration data were reviewed. These were initial calibration (ICAL) and continuing calibration verification (CCV). A curve establishes a graphical plot of instrument response against the different analyte concentrations, and the CCV monitors daily instrument linearity against the initial calibration. The ICAL consisted of standards that were analyzed at five concentrations. These concentrations ranged from the reporting limit to the upper linear range of the instrument. The laboratory calculated the relative standard deviation for each of the target analytes included in the ICAL. The laboratory also calculated the relative response factors (RRFs) for the analytes in the ICAL. The reported percent relative standard deviations and RRFs were compared to the method-prescribed acceptance criteria and validation criteria during the data validation.

A CCV is analyzed every 12 hours to ensure the instrument response is still within method-performance criteria for linearity. The CCV consisted of analyzing a standard at one concentration; the concentration of this standard was generally in the mid-range of the ICAL standard concentrations. The laboratory calculated the percent difference (%D) between CCV and the ICAL. The laboratory calculated the CCV RRFs. The %Ds and RRFs were then compared to the method-prescribed acceptance criteria and validation criteria during the data validation. Results quantitated using an unacceptable %D or RRF value may be may be subject to error.

The ICAL and CCV results were within acceptable limits. No data required qualification on the basis of calibration results.

INTERNAL STANDARD RESPONSES

Under USEPA methods, a given analyte list for organic compounds is segregated by chemical properties and retention time into subsets. An USEPA-defined internal standard with comparable chemical properties and retention times is assigned to each subset of analytes. A known concentration of an internal standard is added to each sample including laboratory QC samples (e.g., calibration standards, matrix spikes, method blank samples) prior to analysis and the instrument internal standard response for each sample is compared to the internal standard response in the daily CCV.

The sample internal standard area count must be within the range of 0.5 to 2 times the CCV area count, and the retention time must be within ±30 seconds of the CCV retention time. If the area count and/or retention times measured for the sample is outside these acceptance ranges, quantitation results for the associated analyte subset may be biased.

Interferences from the sample matrix are typically responsible for internal standard responses that are consistently outside acceptable ranges. Most matrix interferences cause a high or low bias.

Internal standards were added to each of the samples. None of the data was qualified due to measured retention times. The internal standard responses were within acceptable limits, indicating minimal matrix interferences and acceptable sample quantitation.

DUPLICATE SAMPLES

A duplicate sample is a second aliquot of a sample that is prepared and analyzed in the same manner as the original sample. A duplicate sample analysis is performed to measure the precision of the method and to assess possible matrix heterogeneity.

One sample was submitted in duplicate. ERM calculated the relative %D between detected values in each field duplicate pair. The USEPA has not established control criteria based on field duplicate samples; therefore, sample data are not qualified on the basis of field duplicate imprecision. One sample was detected while the other was not. This is not unusual for sample results that are within five times the report limit. The detected duplicate result is presented in Table A-1.

OVERALL ASSESSMENT

None of the data were qualified or rejected based on the data validation. All data can be used for decision-making purposes. The quality of the data generated during this investigation is acceptable for the preparation of technically defensible documents.

Table A-1
Field Duplicate Results and Calculated Relative Percent Differences
Arkema Portland
Portland, Oregon

Lab Package	Sample ID	Compound	Concentration		Report Limit		Units	RPD (%)
			Sample	Duplicate	Sample	Duplicate		
G6H170385	MWA-16I-081506	Total TCDF	<2.9	12	2.9	3.5	pg/L	NC

Key:
RPD = Relative percent difference
NC = Not calculated, one result was detected and the other result was nondetected
pg/L = Picograms per liter
TCDF = Tetrachlorodienzofuran